REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended claim 17 to recite that the hydrophilic water-retaining layer is provided to be in contact with a water-permeable layer that faces flow channels of the fuel and oxidizing gasses. Similarly, claim 18 has been amended to recite that a water-retaining layer of the humidifier is disposed to adjoin a water permeable layer that faces gas flow channels of the stack, and claim 18 has been further amended to recite, in the "whereby" clause, transmission of water "by means of said water permeable layer" when the stack of unit fuel cells is working. Independent claims 22 and 24 have also been amended to recite that the water-retaining layer is in contact with a water permeable layer that adjoins gas flow channels (note claim 22), or that the water-retaining layer faces a water permeable layer that faces the flow channels thereby to transfer water by means of the water permeable layer (see claim 24).

Thus, each of claims 17, 18, 22 and 24 has been amended to recite a water permeable layer facing or adjoining the gas flow channels. Note, for example, pages 10 and 11 of Applicants' specification.

Claim 19 has been amended to recite that water retained in the water-retaining layer is supplied to the flow channels through the water permeable layer from one of, inter alia, part of the opposed surface of the water permeable layer to the surface of the water permeable layer from which water is supplied to the gas flow channels.

In addition, claims 26, 27, 35 and 36 have been cancelled without prejudice or disclaimer.

Independent claim 33 has been amended to recite that the water-retaining layer communicates with a filter disposed at a position where the cooling water inlet and the water-retaining layer are in contact with each other. Note, for example, Fig. 5, as well as Embodiment 3 on pages 25 and 26 of Applicants' specification.

Moreover, Applicants are adding new claims 41-44 to the application. These new claims 41-44, dependent respectively on claims 18, 22, 24 and 33, recite that the water-retaining layer includes a hydrogen oxidation catalyst dispersed in a porous member. Note, for example, Embodiment 8 on pages 33-36 of Applicants' specification.

The RCE Transmittal submitted concurrently herewith is noted. It is respectfully submitted that the present amendments constitute the necessary Submission for this RCE Transmittal; and, moreover, in light of this RCE Transmittal, entry of the present amendments is a matter of right, notwithstanding Finality of the Office Action mailed August 21, 2007.

Rejection of claims 26, 27, 35 and 36 under the first paragraph of 35 USC 112, set forth in Item 3 on pages 2 and 3 of the Office Action mailed August 21, 2007, is moot, in light of cancelling of claims 26, 27, 36 and 36 without prejudice or disclaimer.

Applicants respectfully traverse the rejection of claim 19 under the second paragraph of 35 USC 112, as set forth in Items 5 and 6 on page 3 of the Office Action mailed August 21, 2007, particularly insofar as this rejection is applicable to claim 19 as presently amended.

Thus, claim 19 recites that water retained in the water-retaining layer is supplied to the flow channels through the water permeable layer from one of, inter

alia, part of "a" surface of the water permeable layer opposed to the surface of the water permeable layer from which water is supplied to the gas flow channels. It is respectfully submitted that this recitation in connection with claim 19 sufficiently defines the "opposed" surface, so as to satisfy requirements of the second paragraph of 35 USC 112. In addition, it is noted that claim 19 has been amended to recite "a" surface of the water permeable layer opposed to the surface thereof from which water is supplied to the gas flow channel. In view thereof, it is respectfully submitted that the rejection of claim 19 as including insufficient antecedent basis for "the opposed surface" is moot.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the documents applied by the Examiner in rejecting claims in the Office Action mailed August 21, 2007, that is, the teachings of the U.S. patent documents to Kanazawa, Patent Application Publication No. 2003/0087982, and to Yi, et al., Patent Application Publication No. 2001/0004501, Japanese Patent Document No. 08-138704 (Kawazu '704), No. 08-138705 (Kawazu '705) and No. 07-135012 (Mizuno), under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that these documents as applied by the Examiner would have neither disclosed nor would have suggested such a fuel cell assembly as in the present claims, including a plurality of unit fuel cells, with the fuel cell assembly further including a humidifier adjoining an end of the plurality of fuel cells, the humidifier having a hydrophilic water-retaining layer which has a mean micro-pore diameter of 10-300 μm and a thickness of 50-300 μm, and is provided to be in contact with a water permeable layer that faces flow channels of the fuel and

oxidizing gasses and has one surface to supply water to the flow channels, with water being retained by capillary force by the water-retaining layer when the fuel cells are not working and is taken by gas fed to the anode and cathode against the capillary force when the fuel cells are working. See claim 17.

In addition, it is respectfully submitted that the teachings of the applied documents would have neither disclosed nor would have suggested such fuel cell assembly as in the present claims, having a stack of unit fuel cells, and a humidifier connected to one end of the stack, with a water-retaining layer of a humidifier being disposed to adjoin a water permeable layer that faces gas flow channels of the stack, the water-retaining layer being made of a hydrophilic porous member as discussed previously in connection with claim 17, with water being retained by capillary force by the water-retaining layer when the fuel cells are not working and is taken by gas fed to the anode and gas fed to the cathode by means of the water permeable layer against the capillary force when the stack of unit fuel cells is working. See claim 18.

Furthermore, it is respectfully submitted that the teachings of the applied documents would have neither disclosed nor would have suggested a fuel cell assembly including a plurality of unit fuel cells as in the present claims, and also including a humidifier adjoining an end of the plurality of fuel cells, the humidifier being equipped with a water-retaining layer in contact with a permeable layer that adjoins gas flow channels, the water-retaining layer having micro-pores and a thickness as discussed previously, whereby water is retained by capillary force by the water-retaining layer when the unit cells are not working and is taken by the oxidizing gas against the capillary force by means of the water permeable layer when the fuel cells are working. See claim 22.

In addition, it is respectfully submitted that the teachings of the applied documents would have neither disclosed nor would have suggested such a fuel cell assembly including a plurality of fuel cell units and a humidifier, with the humidifier including a porous water-retaining layer having a mean micro-pore diameter as discussed previously, the humidifier adjoining an end of the fuel cell units such that the water-retaining layer faces a water permeable layer that faces the flow channels thereby to transfer water by means of the water permeable layer introduced into the water-retaining layer to the fuel and/or oxidizing gas flowing in the flow channels. See claim 24.

As discussed in more detail infra, it is respectfully submitted that the teachings of the applied documents do not disclose, nor would have suggested, such structure as in the present claims, including the humidifier having both a water-retaining layer and a water permeable layer as in claims 17, 18, 22 and 24, with the water-retaining layer having micro-pores and/or thickness as in the present claims, and with the water-retaining layer and water permeable layer being positioned relative to gas flow channels of the fuel cells as in the present claims.

In addition, it is respectfully submitted that the teachings of the applied documents would have neither disclosed nor would have suggested such a fuel cell assembly as in the present claims, having a humidifier and a plurality of fuel cell units, and wherein the humidifier comprises a porous water-retaining layer for retaining water supplied thereinto, the porous water-retaining layer being in contact with a channel containing water, and with the water-retaining layer communicating with a filter disposed at a position where the cooling water inlet and the water-retaining layer are in contact with each other, the humidifier adjoining an end of the fuel cells such

that the water-retaining layer faces the flow channels to transfer water introduced into the water-retaining layer to the gasses flowing in the flow channels. See claim 33.

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such fuel cell assembly as in the present claims, having features as in independent claims 17, 18, 22, 24 and 33, as discussed previously, and additionally having features as set forth in the present dependent claims, such as (but not limited to) wherein the porous member (of which the water-retaining layer is made) is made of a hydrophilic polymer material, a carbonaceous porous material, or a composite material thereof (see claim 2); and/or wherein the thickness of a humidifying water inlet of the humidifier is ½ to ¾ of the thickness of the porous member (see claim 3); and/or wherein a water permeable membrane having a function to transmit water is formed on porous material of the water-retaining layer (see claim 4), more particularly, the size and porosity of the water permeable membrane respectively as in claims 5 and 6, and material of the water permeable membrane as in claim 7; and/or wherein the water-retaining layer of the humidifier has a carbonaceous porous filter, as in claim 8; and/or wherein the porous member has a hydrogen-oxidizing catalyst dispersed therein (see claim 9; note also claims 41-44); and/or a power generation system including, inter alia, the fuel cell assembly of claim 18, as in claim 11; and/or wherein the water-retaining layer has a hydrophilic porous member as in claim 13; and/or wherein the water-retaining layer has a porous member provided adjoining the end of the plurality of fuel cell units and has a water supplying surface to supply water to the flow channels, with water being supplied to the water-retaining layer from part of a surface opposite to the water supplying surface of the porous member and/or from the outer edge of the porous

member (see claim 16); and/or wherein water retained in the water-retaining layer is supplied to the flow channels from one of (a) part of a surface of the water permeable layer opposed to the surface thereof from which water is supplied to the flow channels, and (b) the outer periphery of the porous member (see claim 19); and/or wherein the fuel cell assembly has at least two water-retaining layers (see claim 20); and/or wherein the carbonaceous porous filter controls flow rate of water to the water-retaining layer (see claim 21); and/or wherein the water-retaining layer is a material as set forth in claim 23 (see also claims 30 and 38); and/or wherein the humidifier further includes a water permeable membrane, positioned as set forth in claims 25 and 34; and/or further definition of position of the water-retaining layer or water permeable layer as in claim 28 (see also claims 29, 31, 37 and 39); and/or wherein the assembly has a single humidifier (see claims 32 and 40).

The invention as claimed in the above-identified application is directed to a fuel cell assembly including a plurality of unit fuel cells, and a power generation system using such fuel cell assembly. In particular, the present invention is directed to such fuel cell assembly, and such power generation system, including polymer electrolyte fuel cells.

As described on page 1 of Applicants' specification, a unit fuel cell of the polymer electrolyte fuel cell (PEFC) includes a membrane-electrode assembly having a proton exchange membrane, which is a proton-conductive membrane sandwiched between porous electrodes, and a unit cell separator having gas flow channels which supply hydrogen gas to the anode and air (oxygen) to the cathode, respectively. The proton exchange membrane must be kept wet to a certain level, to let protons move; and various mechanisms have been proposed as apparatus to humidify fuel gasses,

as described on pages 2 and 3 of Applicants' specification. Various previously proposed humidifiers have problems such as consuming power, which reduces efficiency of the fuel cell system, and disadvantageously increasing size of the assembly.

Against this background, Applicants provide a fuel cell assembly including a humidifier, which avoids problems of previously proposed humidifiers, avoiding a reduction in efficiency of the fuel cells and avoiding an increase in the size of the assembly. The fuel cell units of the present invention are simply constructed of minimum elements, so that total volume is minimized and is fabricated at reduced cost. Furthermore, the present invention, having a minimal number (e.g., one or two) of humidifiers, is very flexible in design thereof. Applicants have found that the foregoing objectives are achieved by utilizing a humidifier adjoining an end of the plurality of cells, the humidifier having a water-retaining layer, with, e.g., a mean micro-pore diameter and thickness as in various of the present claims, particularly wherein this water-retaining layer is made of a hydrophilic porous member, and wherein this water-retaining layer is used together with a water permeable layer that faces flow channels of the fuel cells, and whereby water is retained by capillary force by the water-retaining layer when the plurality of unit fuel cells is not working and is taken by the oxidizing/fuel gasses against the capillary force when the plurality of unit fuel cells is working. Using apparatus (a humidifier) as in the present invention, excess humidification of the fuel/oxidizing gasses can be avoided, and a simple and effective humidification of the fuel/oxidizing gasses can be provided, with other advantages as discussed previously in this paragraph. Note, for example, the

paragraph bridging pages 9 and 10, as well as the sole full paragraph on page 10, of Applicants' specification.

Through use of the present structure, having the water-retaining layer as in the present claims and the water permeable layer that faces the flow channels, when the fuel cells are not operating the humidifying water held in the water-retaining layer remains held in micro-pores of the water-retaining layer by capillary force, preventing the, e.g., anode gas from being humidified too much and reducing the humidity of the anode gas. Note, for example, page 10, lines 14-23, of Applicants' specification.

Moreover, the gasses (fuel/oxidizing gasses) can be humidified to desired degrees according to flow rate of the gasses, by a simple and efficient technique forcing the water to the gasses fed to the anode and cathode against the capillary force when the plurality of fuel cells is working.

It is emphasized that according to claims 17, 18, 22 and 24, and claims dependent thereon, the humidifier of the present invention is featured by a combination of a water-retaining layer in contact with a water permeable layer that faces gas flow channels. The water-retaining layer retains water therein and does not release water when the cell is not in operation, but when the cell is operating, the water-retaining layer releases water to the water permeable layer because the water permeable layer transfers water to the flow channels.

According to another feature of the present invention as set forth in claim 33 and claims dependent thereon, and shown in Fig. 5 and discussed in connection with Embodiment 3 (note pages 25 and 26 of Applicants' specification), the humidifying water inlet at which the cooling water from the cooling water flow channel touches the water-retaining layer is replaced by a filter (e.g., a porous carbon filter). The cooling

water is supplied to the water-retaining layer through this filter. This can omit the water-permeable membrane, as the filter can control the flow rate of part of the cooling water from the cooling water flow channel to the water-retaining layer. In other words, this Embodiment can control the water content of the water-retaining layer by the filter, and let the water-retaining layer directly humidify the gas even when the water permeable membrane is not provided.

Kawazu '704 discloses a hydrogen gas humidifier constituted with a porous film, and separators which interpose the porous film from both sides and form a hydrogen gas flow path and a water flow path respectively. The porous film 111 is a polyolefin porous film and has a hydrophilic nature. This patent document discloses that water is easily vaporized by receiving heat from both the porous film and the hydrogen gas, humidification being conducted in a state of steam.

In connection with claim 33 and claims dependent thereon, it is respectfully submitted that Kawazu '704 would have neither disclosed nor would have suggested such fuel cell assembly, including wherein the water-retaining layer communicates with a filter disposed at a position where the cooling water inlet and the water-retaining layer are in contact with each other.

It is respectfully submitted that the problem addressed by Kawazu is described on page 3 of the above-identified application. That is, the water-retaining layer in Kawazu is made up only by hydrophilic porous membrane 111 sandwiched between separators 113 and 115. If a pressure difference occurs between the gasses and the channels, the membrane may be deformed in one direction where the inner pressure is lower. Accordingly, the channels may be clogged, or sectional layers of the channels become smaller, increasing an inner pressure drop. Moreover, since the

layer 111 in Kawazu '704 always permeates water, water may be flooded at the time when the cell is not in operation. According to the present invention as in claim 33, including, in addition to the porous water-retaining layer, the filter as set forth in claim 33, amount of water supplied to the water-retaining layer is controlled appropriately by the porosity and/or pore size of the filter, achieving advantages of the present invention.

Mizuno discloses a fuel gas humidifying layer constituted of a water permeable layer and a gas flow path structure. The water permeable layer comprises a film-shaped microporous film made of polypropylene, and a hydrophilic layer formed by laminating nonwoven fabric in a surface of the microporous film. In the microporous film, water is permeated in accordance with a pressure difference between both sides bordering the film.

It is respectfully submitted that Mizuno discloses a fuel cell structure similar to that of Kawazu '704. It is respectfully submitted that Mizuno would have neither taught nor would have suggested the presently claimed structure, including the humidifier with combination of filter and water-retaining layer, the filter being disposed at a position as in claim 33, and advantages thereof.

It is respectfully submitted that the combined teachings of Kawazu '704 and of Kanazawa would have neither disclosed nor would have suggested the subject matter of claim 38.

Kanazawa discloses a method of modifying properties of a polymeric material, without lowering practical strength thereof. This patent document discloses a method for improving polymeric materials including, inter alia, a step of activation-treatment and a step of hydrophilic polymer-treatment. Note, for example, paragraphs [0010]-

[0013] on pages 1 and 2 of this patent document. This patent document also discloses in paragraph [0014], that the method can be utilized for forming water absorption and water retention materials.

Even assuming, arguendo, that the teachings of Kawazu '704 and of Kanazawa were properly combinable, such combined teachings would have neither disclosed nor would have suggested the presently claimed subject matter, including features of claim 33, wherein the water-retaining layer communicates with a filter specifically positioned relative to the cooling water inlet and water-retaining layer, as discussed previously, and advantages thereof.

Applicants respectfully submit that the combined teachings of Kawazu '704 and Yi, et al. would have neither disclosed nor would have suggested the subject matter of those claims rejected thereover in Item 12 on pages 7-10 of the Office Action mailed August 21, 2007, insofar as this rejection is applicable to the claims as presently amended.

Kawazu '704 has been previously discussed.

Yi, et al. discloses fuel cell power plants utilizing a water transport plate having interdigitated flow channels therein to furnish the reactant gasses to the fuel cell. The disclosed structure includes hydrophilic substrate layers within both the anode and cathode support plates, having a predetermined level of porosity and pore size, the structure using a pressure differential between the coolant stream and the reactant gas streams to control the respective distribution of the streams within the pores of the hydrophilic substrates, the structure providing a means for creating a pressure differential between the reactant gas streams and the coolant stream such that the pressure of the reactant gas streams is greater than the pressure of the coolant

stream. Note, in particular, paragraphs [0009]-[0011] on page 2 of Yi, et al. Note, further, paragraph [0014] on page 3, and paragraphs [0037]-[0039] on pages 3 and 4, of Yi, et al. See also paragraphs [0054]-[0056] on page 6, and paragraph [0065] on page 8, of Yi, et al.

Even assuming, arguendo, that the teachings of Kawazu '704 and Yi, et al. were properly combinable, it is respectfully submitted that these combined teachings would have neither disclosed nor would have suggested the structure as in the present claims, including the water-retaining layer and water permeable layer, positioned relative to the gas flow channels, as in the present claims, the water-retaining layer having structure as in the present claims, and advantages of the present invention due thereto.

It is respectfully submitted that the combined teachings of Mizuno and Yi, et al., applied in Item 13 on pages 10-12 of the Office Action mailed August 21, 2007, would have neither taught nor would have suggested the presently claimed invention, including features as discussed previously, such as the combination of water-retaining layer and water permeable layer, the water-retaining layer having features and being positioned relative to the water permeable layer, with the water permeable layer being positioned relative to flow channels, as in the present claims, and advantages thereof.

Again, it is emphasized that Kawazu '704, as well as Mizuno, disclose humidification structure having separators with a porous film therebetween, avoiding deformation of the porous film. It is respectfully submitted that neither Kawazu '704 nor Mizuno would have disclosed nor would have suggested the combination of features of water-retaining layer and water permeable layer as in the present claims, and advantages thereof.

The rejection of claim 3 in Item 14 on pages 12 and 13 of the Office Action mailed August 21, 2007, and rejection of claims in Item 15 on pages 13 and 14 of the Office Action mailed August 21, 2007, are noted. These rejections utilize teachings of references previously discussed. It is respectfully submitted, as contended previously, that the teachings of these references would have neither disclosed nor would have suggested the features of the present claims, including the water retaining layer and water-permeable layer, specifically positioned, and advantages thereof.

The rejection of claim 9 as set forth in Item 16 on page 14 of the Office Action mailed August 21, 2007, is noted. This rejection applied the teachings of Kawazu '705, in addition to the teachings of references previously discussed.

Kawazu '705 discloses a hydrogen gas humidifier constituted with a porous film, a catalyst reaction layer formed on its one side surface, and separators which interpose the porous film and the catalyst reaction layer from both sides and form a hydrogen gas flow path and a water flow path respectively. This patent document discloses that water in the water flow path permeates the porous film and the catalyst reaction layer according to a difference in pressure of water flowing in the water flow path and the pressure of hydrogen gas flowing in the hydrogen gas flow path, with permeated hydrogen gas reversely flowing from the hydrogen gas flow path side to the catalyst reaction layer through the porous film reacting with oxygen dissolved in water by the action of the platinum catalyst.

Even assuming, arguendo, that the teachings of Kawazu '704, Yi, et al. and Kawazu '705 were properly combinable, it is respectfully submitted that such combined teachings would have neither disclosed nor would have suggested that feature of the present invention including the water-retaining and water permeating

layers of the present claims, specifically positioned with respect to each other and with respect to flow channels, and advantages achieved thereby.

Rejection of claims 35 and 36 in Item 17 on pages 14 and 15 of the Office Action mailed August 21, 2007, is moot, in light of cancelling of claims 35 and 36 without prejudice or disclaimer.

In view of the foregoing comments and amendments, and, moreover, in view of the concurrently filed RCE Transmittal, entry of the present amendments, and further examination and allowance of all claims presently pending in the above-identified application, are respectfully requested.

Applicants request any shortage in fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case 520.43216X00), and credit any excess payment of fees to such Deposit Account.

Respectfully submitted,

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